

San Rafael River Bridge Expansion Joint Replacement (Interim Report)

Experimental Feature – New Products

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Abstract

UDOT's Structures Division is interested in investigating new materials for bridge deck joints. The experimental product in this evaluation is Ure-Fast PF-60 elastomeric concrete. The material was placed on a bridge in central Utah on State Route 24 that spans the San Rafael River (Fig. 1&2).

The material was used not recommended by the supplier. UDOT did not use the material as an expansion joint, but rather as a quasi-rigid joint. The material has shown good durability after one and a half years in place. There are signs of problems with the present application of the material. It appears as though the bridge expands more than expected, and as a result, the concrete surrounding the joint is showing signs of failure. UDOT Research estimates this is a compressive failure as a result of the expansion of the bridge. The Ure-Fast PF-60 appears to be stronger in compression than the surrounding concrete. The Ure-Fast PF-60 also appears to be lifting in order to relieve some of the compressive forces. Analysis through the winter will determine if the lip caused by this lift will catch on snowplow blades. The preliminary conclusion is this material alone cannot be used to replace an expansion joint on a bridge with at least the same amount of expansion.



Figure 1-Structure OF 202 over the San Rafael River



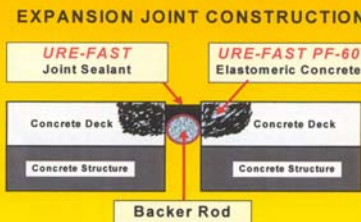
Figure 2-Three joints on the structure

Introduction

UDOT's Structures Division manages over 2700 bridges throughout the State. One of the more common problems UDOT has is replacing expansion joints as they wear. UDOT's current practice is to saw-cut the existing joint and replace it with a new one. This process requires setting the new joint into a concrete mix that takes 14-28 days to cure. This delay creates a tremendous traffic control issue, particularly in urban areas.

There are many different types of products that have been developed in an attempt to solve this problem. UreFast PF-60 is a synthetic polyurethane material that is distributed by Sullivan Supply Company (Fig. 3). Cure time can be as little as 10 minutes, which significantly reduces the traffic control problems.

EXPANSION JOINT CONSTRUCTION



EXPANSION JOINT CONSTRUCTION

URE-FAST Joint Sealant

URE-FAST PF-60 Elastomeric Concrete

Concrete Deck

Concrete Structure

Backer Rod

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One that takes less time to construct?
Requires fewer labor hours? Less time for lane closures?


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PF-60 SOLIDIFIES IN 1 MINUTE



Sullivan Supply

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Figure 3-Ure-Fast PF-60 brochure from Sullivan Supply

Background Information

Kleston Laws, Price District Engineer identified a bridge (OF-202) that he would like to test Ure-Fast PF-60 on as an experimental test section. The bridge spans the San Rafael River, was built in 1971, and is located on SR-24 about 6 miles south of I-70 (Fig. 4&5). The approximate bridge span is 215 ft; composed of a pre-stressed concrete girder bridge with a 4 ft concrete parapet railing.

One reason this site was an ideal location is the amount of traffic (AADT = 420). Although SR-24 is a major route to Lake Powell, and the construction took place during boating season, this road experiences little traffic during the workweek. This fact increased the safety of the workers on the project and reduced the necessary traffic control.

The existing expansion joints at this structure had failed. Engineers thought the expansion on this bridge was not enough to warrant an expansion joint. Engineers with the advice of Sullivan Supply Company suggested using UreFast PF-60 in place of an expansion joint since they thought the material would be flexible enough to relieve the expansion stresses.



Figure 4-Location is about 6 miles south of I-70

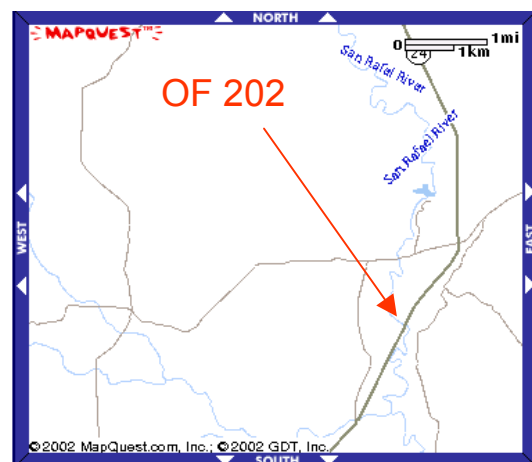


Figure 5-Over the first crossing of the San Rafael River

Construction Information

Ure-Fast PF 60 is referred to as an elastomeric concrete. It is a system that includes gravel, backer rod, and liquid polymer. The installer first completely removes the existing expansion joint system (Fig. 6). This was done in sections on this project in order to allow traffic to pass. The installer then places the backer rod into the expansion joint (Fig. 7&8). The installer laces gravel in the void left by the old expansion joint system (Fig. 9) and then applies the liquid polymer to the gravel (Fig. 10), which forms a polymer-concrete. The final step is to apply a thin layer of gravel to the surface for a gravel finish (Fig. 11). The liquid polymer takes only minutes to cure, so traffic can be released onto it in much sooner than contemporary methods.



Figure 6-Cleaning removed expansion joint channel cut



Figure 7-Installing backer rod



Figure 8-Installing backer rod



Figure 9-Pouring in the gravel



Figure 10-Applying polymer liquid and gravel finish



Figure 11-Finished product

Goal

The goal of this research is to determine if Ure-Fast PF-60 performs as well, installs as easily, cures as fast, and endures as well as the manufacturer claims. Also, the goal of this research is to determine if this application of Ure-Fast PF-60 is proper.

Objectives

The objectives of this research to reach the goal are:

1. Review research of this and other products.
2. Research the performance of this product in other states.
3. Evaluate the benefits and limitations during construction.
4. Evaluate the product performance in the field.
5. Evaluate the cost-effectiveness of this product.

Preliminary Results

Objective 1: Review research of this and other products

There has been little research done on expansion joint materials. On this project, the product was intended to actually remove the joint. There have been many studies conducted on integral or semi-integral abutment (jointless) bridges, but none on the removal of expansion joints. UDOT Research can provide the literature search results for jointless bridges if requested.

Objective 2: Research the performance of this product in other states

Sullivan Supply Company gave a list of other states that had installed this product. The list included employee names of the states of Oregon, Washington, and Colorado DOTs.

Oregon DOT: The contact in Oregon was from the Dalles area. He said they use UreFast PF-60 for crack sealing decks before overlaying. When asked if they had used the material in a similar fashion as this project, he responded that his region had not. He said he was impressed with the material and had recently re-visited a site where the material was used as a polymer overlay. The material had held up well for two years even though the region used a lot of studded tires.

The contact also mentioned that his region might not be comparable with Utah since the region does not experience as many temperature extremes as Utah.

Washington DOT: Jim Henderson said they are happy with the product. He said they don't use this product alone as an expansion joint. He will typically remove the extruded metal from the joint, take the joint back about 2" then use the UreFast PF-60 in combination with a polymer expansion joint sealant (Ure-Fast liquid sealant) that supports up to 2" of expansion/contraction. He said they typically only treat bridges up to spans from 40' to 140'. He said they do use the UreFast PF-60 for pothole repairs because of the speed of installation.

Colorado DOT: Tom Young said they are happy with the PF-60. He has used it to replace finger joints on small structures with success. Colorado does not use the PF-60 to fill the whole joint. He said they use the PF-60 to fill the void left by the existing expansion joint, but use the backer rod and Ure-Fast liquid sealant to seal the joint. This method is the same as given in the brochure picture (see Appendix).

Objective 3: Evaluate the benefits and limitations during construction.

The largest benefit of this product is that it required minimal time to construct compared to contemporary methods. The total process took one day to complete. The longest part of the process was the removal of the existing joint and the cleaning of it. The placement and curing of the material took about 1 hour per joint. Contemporary methods could not have been used on this project because it would require at least one lane of a two-lane road to be closed for a period of 14-28 days. Cutting the time down to hours made the expansion joint rehabilitation possible.

Objective 4: Evaluate the product performance in the field.

The product was placed in April 2001. Research visited the test site on November 26, 2002. The condition of the experimental material was excellent. The material showed no signs of cracking or spalling. However, the concrete adjacent to the product was beginning to spall (See Appendix).

The opinion of UDOT Research is that the expansion of the bridge deck had transferred through the product and caused the concrete on either side of the product to fail in compression. It appeared as though the compressive strength of the product exceeded that of the concrete. The Structures Division Inspectors rated the condition of the bridge deck as “satisfactory” on an excellent to poor scale (the condition of the bridge deck was “bad” in the opinion of the evaluators). This may have contributed to the spalling in the concrete. Research will continue to evaluate the condition of the product as well as its interaction with the concrete deck until fall of next year.

Objective 5: Evaluate the cost-effectiveness of this product.

The cost-effectiveness of this product has not been evaluated yet.

Preliminary Conclusions

- Ure-Fast PF-60 is easy to install and is much quicker than using concrete.
- Ure-Fast PF-60 appears to have a stronger compressive strength than the surrounding concrete although the typical properties given by the manufacturer contradict this.
- Ure-Fast PF-60 has some elastic properties, but not enough to absorb the thermal expansion of the bridge at this location. The result of this is the compressive failure (spalling) of the concrete at the joint.
- Some states use Ure-Fast PF-60 with success, but use Ure-Fast liquid sealant to seal the joint.
- Ure-Fast PF-60 is “squeezing” out of the joint. This may be a problem for snowplowing.
- Ure-Fast PF-60 is not appropriate as a stand-alone product for eliminating expansion joints with this much expansion.

Preliminary Recommendations

Ure-Fast PF-60 should not be used in the future to replace expansion joints on bridges that have at least as much expansion as this bridge. The material may work alone in another location where the bridge does not expand as much as this bridge.

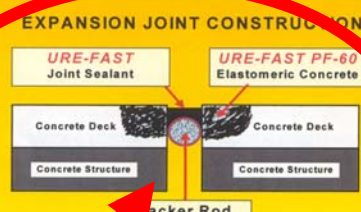
Ure-Fast PF-60 can and should be used with the Ure-Fast liquid sealant to replace the joint (See Appendix). Other states have had success with this combination.

Ure-Fast materials may be a good overlay product for locations where durability of the overlay is a problem. Oregon DOT has had early success with Ure-Fast products as an overlay.

Appendix

Suggested Use

EXPANSION JOINT CONSTRUCTION



EXPANSION JOINT CONSTRUCTION


URE-FAST Joint Sealant

URE-FAST PF-60 Elastomeric Concrete

Concrete Deck

Concrete Structure

Rebar Rod



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Notice the material is not continuous through the joint. In UDOT's application there is no joint sealant; the material is continuous.

The joint should be carried up through the product and sealed with a liquid sealant.

URE-FAST PF-60


PRODUCT DATA

URE-FAST PF-60 is a two-part liquid polymer used in the repair and rehabilitation of concrete and asphalt-concrete pavements. When used in combination with crushed aggregate, the enhanced polymer forms a high performance, rapid setting, resilient *polymer concrete*. Within minutes of placement, durable, long-lasting repairs are able to handle vibration, heavy traffic, and thermal movement.

SUPER FAST-SETTING Simplified application equipment **FASTCAT** siphons the nearly water-thin liquids (A & B) from their respective containers through separate hoses and mixes them in a nozzle just prior to application. The mixed liquid is flooded or sprayed over aggregates, or poured into cracks, solidifying in one minute. The cured solid is suitable for repairing and sealing spalls, potholes, cracks and expansion joint headers.

USES		TYPICAL PROPERTIES																												
<ul style="list-style-type: none"> • Crack Sealing AC & PCC Pavements • Repairing Potholed Pavements • Waterproofing Decks for Vehicular & Pedestrian Traffic • Creates Non-Skid & Traction Surfaces • Spall Repair • Rebuilding Expansion Joint Nosings • Creating Transition Ramps between Mismatched Slabs/Grades • Cable & Conduit Sealant 	<p>FEATURES</p> <p>Bonds Without Primer No priming is required for bonding to concrete, asphalt-concrete, steel or wood.</p> <p>Seals & Protects Creates semi-flexible waterproof membrane that protects substrate from freeze-thaw spalling. Stops further corrosion of reinforcing steel.</p> <p>Fast Repair & Cure Solidifies in less than 1 minute. Traffic ready in 10 minutes.</p> <p>Year Round Use Successful repairs in freezing weather or in the heat of summer.</p> <p>Safe to Use No toxic fumes during application. No odor.</p>	<p>Application</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th></th> <th>A</th> <th>B</th> </tr> </thead> <tbody> <tr> <td>• Ratio</td> <td>1</td> <td>1</td> </tr> <tr> <td>• Viscosity @ 73F, cps</td> <td>80</td> <td>102</td> </tr> <tr> <td>• Appearance</td> <td>Amber</td> <td>Black</td> </tr> <tr> <td>• Specific gravity</td> <td>1.11</td> <td>1.03</td> </tr> </tbody> </table> <p>Cured</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tbody> <tr> <td>• Specific Gravity, ASTM, D-792</td> <td>1.08</td> </tr> <tr> <td>• Hardness, Durometer A, ASTM, D-2240</td> <td>60</td> </tr> <tr> <td>• Tensile Strength, psi, ASTM, D-412</td> <td>2000</td> </tr> <tr> <td>• Compressive Strength, psi ASTM C-39</td> <td>1580</td> </tr> <tr> <td>• Elongation at break %, ASTM, D-412</td> <td>160</td> </tr> <tr> <td>• Bond Strength, psi, ASTM, C-882</td> <td>760</td> </tr> </tbody> </table>		A	B	• Ratio	1	1	• Viscosity @ 73F, cps	80	102	• Appearance	Amber	Black	• Specific gravity	1.11	1.03	• Specific Gravity, ASTM, D-792	1.08	• Hardness, Durometer A, ASTM, D-2240	60	• Tensile Strength, psi, ASTM, D-412	2000	• Compressive Strength, psi ASTM C-39	1580	• Elongation at break %, ASTM, D-412	160	• Bond Strength, psi, ASTM, C-882	760	<p>Important Notice</p> <p>Recommendations for product use are based on tests believed to be reliable. Field conditions vary widely. For this reason, the user must determine product suitability for the particular use and specific applications. Read Material Safety Data Sheets and Installation Instructions before using. Install between 20° and 100° Fahrenheit ambient temperature, and 50°-80° Fahrenheit material temperature. Do not apply during rain or on wet surfaces.</p>
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Manufactured by URE-FAST INDUSTRIES
Division of M.M.A Products Ltd.
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Thunder Bay, Ontario



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Material information brochure provided by Sullivan Supply

Problem Photos



Illustrations of the material “squeezing” out of the joint due to thermal expansion



Illustrations of the adjacent concrete spalling



Notice one section is raised and the other is not. Maintenance crews have sealed the lip for snowplow operations